BRIEFER ARTICLES

USE OF DILATOMETER IN STUDYING SOIL AND PLANT RELATIONSHIPS

The dilatometer was used successfully by BOUYOUCOS[1] in studying the forms of water in soils, and in studying the freezing point lowerings of soils and plants, MCCOOL and MILLAR[2] observed that the time of day when samples of plants were taken markedly influenced the freezing point lowerings of the leaves. The density of the sap was found to increase from morning until noon, and again decrease in the afternoon, reaching its lowest point at night. By means of the dilatometer the amount of water that froze readily was less at noon than in the morning, the freezing point lowerings apparently being governed somewhat by the form of water in the tissues.

We have repeated some of the experiments that were previously reported, and obtained additional information by means of the dilatometer. There are certain precautions that should be taken in making determinations of the amount of water that freezes in plant tissues by means of the dilatometer.

The sample is quickly weighed, inserted into the bowl of the dilatometer, and ligroin added. It is advisable to remove air bubbles either by shaking or by means of a suction pump. Where a bath of about $-1.5°$ C. is employed, 10 gm. of the tissue may be used; but with colder baths, such as -4 or $-6°$ C., it is imperative that much smaller quantities of tissue be added to the dilatometer, in order that supercooling may be brought about. With some plants 2 gm. are ample, while with others somewhat larger amounts may be employed to advantage. It is very difficult to accomplish supercooling if the freezing mixture or the dilatometer is agitated while the temperature of the material is being lowered. When equilibrium has been attained, solidification may be accomplished readily by agitating the dilatometer.

Several plants have been employed, namely, rye, wheat, corn, sweet clover, and red clover. They were grown on fertilized and untreated

[1] Tech. Bull. no. 36, Mich. Exper. Sta.

[2] The water content of the soil and the composition and concentration of the soil solution as indicated by the freezing point lowerings of the roots and tops of plants. Soil Sci. 3:113–138. 1917.

soils. The amounts of water that froze at different temperatures are reported in table I.

TABLE I

AMOUNT OF WATER FREEZING IN LEAVES OF PLANTS AT DIFFERENT TEMPERATURES

Crop	Date	Weight of material (gm.)	Freezing point lowering	Cc. water that froze		
				−1.5° C.	−4° C.	−6° C.
Rye.....	Nov. 24	5	0.928	0.90	2.50	.....
Rye.....	May 17	5	1.030	0.86	2.40	2.90
Wheat.....	Nov. 24	5	1.107	0.40	2.65	.....
Sweet clover.	Nov. 24	5	0.906	1.22	2.86	.....
Red clover...	May 15	5	0.780	1.70	2.70	2.90
Corn.....	June 10	5	0.578	2.10	2.40	.....

Marked variations in the amount of water that froze at −1.5° C. were observed, and while the amount increased with the lower temperatures, less differences were recorded.

The effect of the concentration of the soil solution and the water content of the soil were determined. The density of the solution in the soil was increased and so maintained by additions of the three salt solutions of SHIVE and the soil placed in 3 gallon jars and plants grown therein. The containers were placed in the open and exposed except when it rained.

Marked increase in the density of the soil solution resulted in little if any effect on the amount of water that froze at −2.5° and −4° C. respectively. The results are not given, inasmuch as MILLAR is to report them in another article.

The amount of water in the soil affected the quantity of water that froze in the plants grown therein. Corn was grown 60 days in sandy loam soil containing 9.5 and 15.6 per cent water respectively; 44.1 per cent of the loss in weight of the corn upon drying, froze at −2.5° C., and 63.9 per cent at −4° C. in the former and 51.8 and 84.8 per cent respectively in the latter. Similar results were obtained with barley.

In another series the moisture content of the soil was varied, but the concentration of the soil solution was kept about the same throughout the experiment by additions of the nutrient solution. In case of the higher temperature the results obtained were the reverse of those just given, or the amount of water that froze in the corn plant increased with a decrease in the water content of the soil when the nutrients were added. Slight differences were observed when the tissue was exposed to a temperature of −4.5° C.

This raises the question as to the effect of the composition of the soil solution upon the amount of easily freezable water in plant tissue. Possibly we shall be able to present results of experiments dealing with this question at a later date. It seems that the amount of water that readily freezes in the roots, stems, leaves, fruits, and seeds of plants and the factors that affect the freezing should be of general interest, at least to the physiologist, and it is probable that a knowledge of it would be valuable especially where the changes in the concentration of the cell contents of plants as well as winter injury are being investigated.

The difficulty encountered in causing tissues to solidify at the higher temperatures, especially when small amounts are used in the determinations, raises some important questions relative to winter injury of plants grown in different soils. It is possible and probable that some soils do not solidify, although the temperature may go appreciably below the freezing point. It is very easy to cause a sandy soil to solidify without much supercooling; with clay it is more difficult; while it is far more difficult in case of muck or peat. Instances have been observed where fruit trees growing in sandy soils have been severely injured by low temperature, while those growing in adjacent soils largely escaped. It is true, however, that sandy soils are more responsive to air changes than are the finer textured ones.—M. M. McCool and C. E. Millar, *Michigan Agricultural College, East Lansing, Mich.*

ISOLATING SINGLE SPORES

(WITH ONE FIGURE)

A new method of isolating single spores has been devised, which differs from other methods in common use in the substitution of a mechanical method of marking the location of the spores in the poured plates for the usual procedure of marking with ink-dots under the microscope. A cylinder of brass about the length of the ordinary 1.9 mm. objective is turned in the form shown in fig. 1, one end being provided with a thread like that of the objectives of the microscope to be used, and the other turned down and the end hollowed out so as to form a tube of the size desired.

This device is then screwed into the revolving nosepiece of the microscope in place of one of the objectives. The cover is now removed from the Petri dish containing the poured plates, and the spores are located under the microscope. When a spore is located with the objective, the tip of the marker is sterilized by flaming it with a gas burner or alcohol lamp, the nosepiece is rotated so as to bring the marker